Light

Reflection and Mirrors

Read to Learn

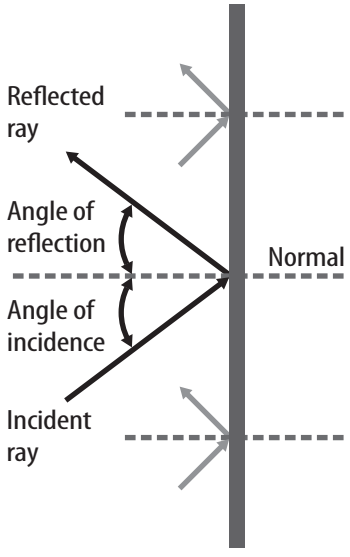
Reflection of Light

Reflection is the bouncing of a wave off a surface. If you throw a tennis ball straight at a wall, it will bounce back to you. Where on the wall would you throw the ball so that a friend standing to your left could catch it? You would throw it toward a point on the wall halfway between you and your friend.

Law of Reflection

Light reflects a lot like a tennis ball bouncing off a wall. Straight arrows called rays show how light reflects, as seen in the figure. An imaginary line perpendicular to a reflecting surface is the normal. The light ray moving toward the surface is the incident ray. The light ray moving away is the reflected ray. Notice the angle formed where an incident ray meets a normal. This is the angle of incidence. A reflected ray forms an identical angle on the other side of the normal. This angle is the angle of reflection. According to the **law of reflection,** *when a wave is reflected from a surface, the angle of reflection is equal to the angle of incidence*.

Law of Reflection

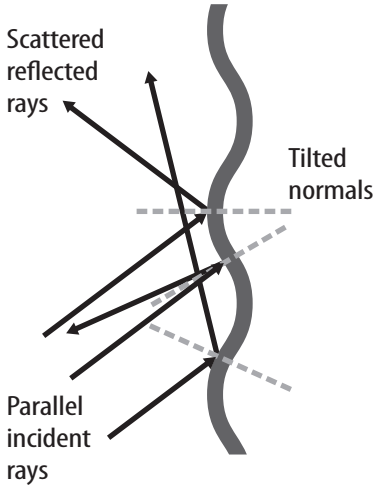


Regular and Diffuse Reflection

You see objects when light reflects off them into your eyes. Why can you see your reflection in smooth, shiny surfaces but not in a piece of paper or a painted wall? The law of reflection applies whether the surface is smooth or rough.

Shiny Surfaces *Reflection of light from a smooth, shiny surface is called* **regular reflection.** Look back at the figure on the previous page. The three incident rays and the three reflected rays are all parallel. You see a sharp image when parallel rays reflect rays reflect into your eyes.

Diffuse Reflection



Rough Surfaces When light strikes an uneven surface, as in the figure at right, the angle of reflection still equals the angle of incidence at each point. However, different rays reflect in different directions. *Reflection of light from a rough surface is called* **diffuse reflection.**

Mirrors

Any surface that reflects light and forms an image is a mirror. The type of image depends on whether the reflecting surface is flat or curved. The image forms when light reflects off an object to a reflecting surface. The surface reflects the light back to your eye. Your brain knows that light travels in straight lines, so it understands this light as an image of the object.

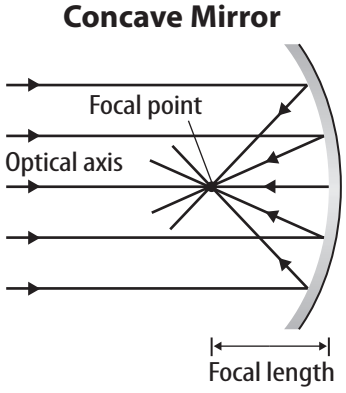
Plane Mirrors

The word *plane* means "flat," so a plane mirror has a flat reflecting surface. The image a plane mirror forms is the same size as the object. However, it is a virtual image because no object is located at the place where the image appears. A virtual image is an image of an object that your brain perceives to be in a place where the object is not.

Suppose you look at your image in a plane mirror. If you raise your right hand, your image raises its left hand. However, up and down are not reversed. The image you see in a plane mirror is not simply flipped around. Instead, you see an object as if you were viewing it from just behind the surface of the mirror.

Concave Mirrors

Not all mirrors are flat. *A mirror that curves inward is called a* **concave mirror**, like the mirror shown in the figure. A line perpendicular to the center of the mirror is the optical axis. The law of reflection determines the direction of reflected rays in the figure at right. When rays parallel to the optical axis strike a concave mirror, the reflected rays converge, or come together.



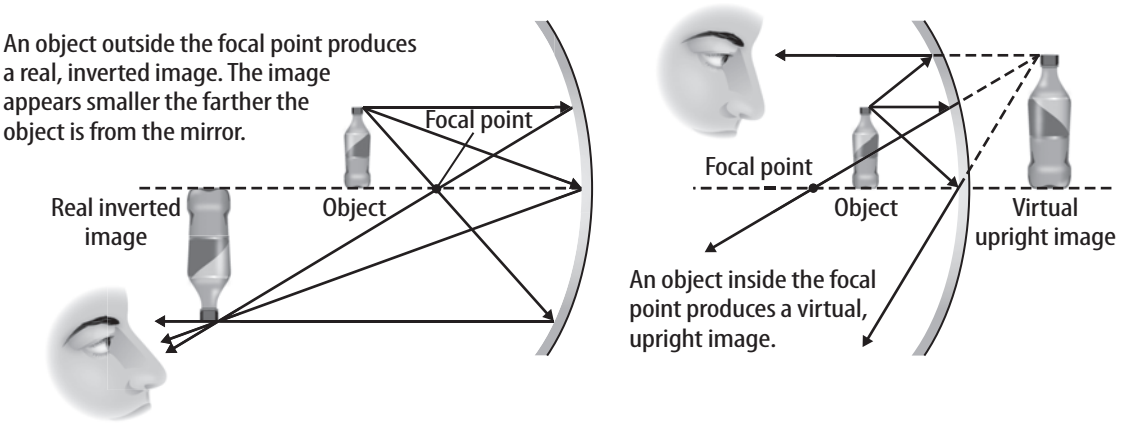
Focal Point Look at the figure. Notice the point where the rays converge. *The point where light rays parallel to the optical axis converge after being reflected by a mirror or refracted by a lens is the* **focal point.** You will learn about lenses in the next lesson.

Imagine that a concave mirror is part of a hollow sphere. The focal point is halfway between the mirror and the center of the sphere. *The distance along the optical axis from the mirror to the focal point is the* **focal length.** The lesser the curve of a mirror, the longer its focal length. The position of an object compared to the focal point determines the type of image formed by a concave mirror.

Look again at the figure of the concave mirror to understand how a flashlight works. Imagine all the arrows pointing in the opposite direction. The bulb is at the focal point. The concave mirror behind the bulb is the reflector. Light rays from the bulb strike the mirror and reflect as parallel rays.

Types of Images A concave mirror can produce a real or a virtual image. The type of image a concave mirror forms depends on the object's location relative to the focal point, as shown in the image at the top of the next page. The image is virtual if the object is between the focal point and the mirror. The image is real if the object is beyond the focal point. A real image is one that forms where rays converge. No image forms if the object is at the focal point.

Real and Virtual Images of Concave Mirrors



Inverted Images Suppose you look at your reflection in the bowl of a shiny spoon. If your face is outside the spoon's focal point, your image appears upside down, or inverted. Your image disappears when your face is at the focal point. When your face is inside the focal point, the image is upright.

Convex Mirrors

Have you ever seen a large, round mirror high in the corner of a store? The mirror enables workers at the store to see places they cannot see with a plane mirror. *A mirror that curves outward, like the back of a spoon, is called a* **convex mirror.** Light rays diverge, or spread apart, after they strike the surface of a convex mirror. Your brain interprets these rays as coming from a smaller object behind the mirror. Therefore, a convex mirror always produces a virtual image that is upright and smaller than the object being reflected.

As you have read, convex mirrors and plane mirrors form only virtual images. However, concave mirrors can form both virtual images and real images.